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ABSTRACT

This collection of eight lesson plans is designed to assist teachers in providing mathematics instruction to elementary and secondary education students with different types of disabilities. The lessons use tactics for teaching mathematics content derived from Lovitt (1995), who summarized techniques found to be effective in increasing the mathematics achievement of students with learning disabilities, emotional challenges, and mild mental retardation. The tactics for teaching mathematics content provide supports in the form of augmenting metacognitive behaviors, the mnemonic memory enhancer, and heuristics. The lessons reflect a variety of curricular adaptations. Changes were made in lesson format, teaching style of delivery of instruction, time required to complete a task, amount of assignment to be completed, objectives, evaluation criteria, environmental and social conditions, learning materials, and level of support or assistance. The lessons are structured for cooperative group learning for groups ranging in size from two to six members depending on the social competence of the students. Each lesson addresses five basic features of a cooperative group learning lesson: positive interdependence, face-to-face interaction, direct teaching of interpersonal and small-group interaction skills, reflective evaluation of the social skills and the academic task, and individual accountability. (CR)

Cooperative Group Learning

ED 455 638

CONNECTING THE PIECES

K-12 Mathematics Lesson Plans

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COLLEGE OF EDUCATION

SPECIAL EDUCATION TEACHER EDUCATION PROGRAM

SPRING 2001 INTERNS

[Edited by Ann Nevin and Diane Renne]

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The lesson plans* in this document were collaboratively developed and edited by
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Cooperative Group Learning

K-12 Mathematics Lesson Plans

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Introduction

The tactics for teaching mathematics content were derived from Lovitt (1995) who summarized techniques found to be effective in increasing the mathematics achievement of students with learning disabilities, students with emotional challenges, and students with mild mental retardation. The tactics provided supports in the form of augmenting the learner's **metacognitive behavior** such as the think-aloud "Say It Before You Do It" *learning* strategy (Lovitt, 1995, p. 245-247), the **mnemonic memory enhancer** ("RIDGES" for problem solving found in Lovitt, 1995, pp. 268-269), and **heuristics** (Lovitt, 1995, 265-267). Other tactics provided supports in the form of augmenting the **antecedents** found in the assignment itself such as the "Cue, Then Fade" *teaching* strategy (Lovitt, 1995, pp. 251-254) or "Demonstration and Model" teaching strategy (Lovitt, 1995, pp. 255-257). Teachers altered the **consequences** in the lessons for tactics such as the Group Contingencies/Peer Tutoring (Lovitt, 1995, pp. 262-264).

These lessons reflect a variety of **curricular adaptations**. Curricular adaptations included modifications that teachers make in their curricular content to accommodate the specific learning needs of students with disabilities. Changes were made in *lesson format* (for example, deciding to use the cooperative group learning process instead of a direct instruction format), *teaching style or delivery of instruction* (for example, ensuring that both input and output are multisensory with visual, auditory, and kinesthetic cues), *time* required to complete a task (for example, allowing some students extra time), *amount of assignment to be completed* (for example, dividing the assignment by 4 so that in a 4-person group, each person completes ¼ of the total), objectives (goals), *evaluation criteria* (for example, adjusting the range of accuracy required for mastery or the time required to perform the assessment), *environmental and social conditions* (such as scheduling a cooperative group learning lesson to occur immediately after a quiet activity so as to provide balance), *learning materials* (for example, providing age-appropriate material at the student's independent reading level), and *level of support or assistance* (for example, providing a laptop or an augmentative communication device as assistive technology).

Teachers structured cooperative group learning for mathematics lessons so their students worked together in groups ranging in size from two to six members depending on the **social competence** of the students. The students worked cooperatively to achieve a common goal (in this case, learning their mathematics). Social interaction skills were fostered by assigning roles and responsibilities to each group member so that students do not revert to working independently or competitively. The completion of the academic task was dependent upon the participation of all group members and involves explaining the underlying cognitive strategies that result in accuracy. Learning games often embed cooperative skills within a light hearted fun competition. Each lesson in this volume addressed the 5 basic features of a cooperative group learning lesson (Johnson, Johnson, & Holubec, 1998) as shown in the table on the following page.

It is important to note that these cooperative group learning lessons[1] were designed with a specific population of learners in mind. The special education interns worked with mentors (certified special educators) in elementary and high schools located in a suburban area of a large metropolitan city in the southwestern United States. The schools included a wide range of ethnically and linguistically diverse populations (heritages included African-American, Hispanic, Asian, and Anglo). Thus it was important to make sure that the lessons included **Sheltered Instruction** and **SDAIE** (Specifically Designed Academic Instruction in English) strategies (Walter, 1998) such as matching language with experience and asking questions, giving directions, and advancing students to higher levels of Bloom's Taxonomy (from recalling to evaluating). Moreover, cooperative group learning lessons result in increased **Self determination** (Wehmeyer, Sands, Doll, & Palmer, 1997). Students become more self-regulated with regard to successfully negotiating cooperative group lessons and more confident in completing tasks as members of a team.

[1] The lessons in this volume were designed as part of an assignment for special education methods classes. Interns field-tested the lessons by implementing them in a micro-teaching situation with each other under the supervision of Dr. Renne. Some interns carried out the lessons with the students in their mentor teacher's classrooms. Some interns edited their lessons and included them in their Lesson Plan Portfolios under the supervision of Dr. Nevin.

5 Basic Features of Cooperative Group Learning

Feature	Definitions	Teacher Actions
1. Positive interdependence	Each group member has only a portion of the resources, information, or materials needed to complete a task, and the members' resources must be combined for the group to achieve its goals.	Assign one goal for the team; Structure materials so that students must share; Set up one reward for the entire team to enjoy upon successful completion.
2. Face-to-face interaction	Group members encourage and facilitate each other's efforts to achieve, complete tasks, and produce in order to reach the group's goals.	Set up chairs and desks so students face each other
3. Direct teaching of interpersonal and small-group interaction skills	In addition to the academic objective, students learn and practice social competencies. Teachers include direct teaching for trust building, leadership, and conflict resolution. Specific lessons focus on how to give and receive feedback, how to paraphrase, and how to keep the group on task or bring the group back to the task, etc.	Assign specific roles such as facilitator, encourager, paraphraser, jargon-buster, clarifier, coordinator, time keeper, etc.
4. Reflective evaluation of the social skills and the academic task	Each group member describes what actions were helpful and unhelpful. The group agrees on what actions to continue or change. The purpose is to clarify and improve the effectiveness of each member's contributions to the collaborative effort to achieve the group's goals	Monitor each student's social interactions and reports back to the group; Intervene to teach the social skills or academic skills when needed.
5. Individual accountability	Individual accountability in cooperative group learning exists when the performance of each student is assessed, the results are provided to the individual and the group, and the student is held responsible by teammates for contributing his or her fair share to the group's success. Individuals who need more assistance, support, encouragement, and other accommodations to complete the assignment are acknowledged.	Use Kagan (2001) Numbered Heads Together. Assign each member a number: 1, 2, 3, or 4. Ask a question about the assignment, call out randomly "1." Allow time for teams collaborate to decide what the answer is. Ask all the 1s to stand to report for their respective team. Select one to report and check other teams whose reporters signal agreement/disagreement by a thumbs up or thumbs down.

A Cooperative Group Learning Lesson for K-6 Students with Multiple Disabilities
Number Recognition and Simple Addition: The "Fading Props" Strategy
By Tracy Brown and Donna Pryer

Arizona Mathematics Standard 1: Number Sense: Students develop numbers sense and use number relationships to acquire basic facts and to solve a wide variety of real-world problems and to determine the reasonableness of results.
FUNCTIONAL (Ages 3-21 for students functioning at less than a 36 month developmental stage):
Within the functional context of home, school, work, and community environments, students will know and are bale to do the following:
IM-FS2. Demonstrate one-to-one correspondence between elements in collections (sets) {e.g., nine blocks is as many as nine ducks)
PO 1. Match group shaving equal numbers of objects up to 100
PO 2. Using a model of sets up to ten, complete partial sets (determine how many more or less are needed)
Short Term Instructional Objective: Given a random assortment of numerals on two dice with numerals on each side and another dice with operations signs (+ for addition and – for subtraction), students will roll the dice at least 5 times, say the numeral and the operation, and solve the equation by using a number chart, with 90-100% accuracy within a 30 minute lesson as determined by teacher observation.
Social Skill Emphasis: Students will practice the social skill of paying attention to their classmates while each person rolls the dice.
Individual Accountability: Each student will have 5 opportunities to roll the dice and orally state the equation, and solving by counting out on the number line.

Teacher Actions to Set Up the Face-to-Face Positive Interactions

1. Have the students sit in groups of 4 in close proximity to each other.
2. At each table, arrange the dice and number lines. There is one set of dice and one number line per group so as to ensure the social skill of sharing materials.
3. Assign the social skill of listening to each student by giving each one a nametag with a picture of an ear. Explain that the teacher will be watching to see if they are listening as each team mate takes a turn.
4. Have the student with the shortest haircut at each table begin by rolling the dice.
5. At least one student at each table will be using an augmentative communication device. Make sure the device is programmed with the numerals and operations signs so that the student can respond appropriately.
6. At least one student at each table will be using sign language. Make sure there is a sign chart posted on the wall in clear view for all the students to see so that they can recognize and interpret the sign.
7. The teacher circulates to each table, eavesdropping to make sure that the students count out the appropriate numbers and solve the equations using the number line. Check that listening is occurring.
8. When each student has completed 5 rolls, the teacher stops the game and asks the following questions:
    a. How did you do using the number line? What made it easy for you to do this? What made it hard?
    b. How did you do with the listening job? What did you do to show your team mate that you were listening? What did you do that showed your were not listening?
    c. What will you do to improve your listening the next time we play this game?

Monitoring the Social Interaction and Academic Achievement

The teacher used a task analysis checklist to monitor the student's accuracy and frequency. Notations were made related to how well the student practiced the listening skill.

Sample Augmentative Communication Board Display

0	1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18	19
20	21	22	23	24	25	26	27	28	29
30	31	32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47	48	49
50	51	52	53	54	55	56	57	58	59
60	61	62	63	64	65	66	67	68	69
70	71	72	73	74	75	76	77	78	79
80	81	82	83	84	85	86	87	88	89
90	91	92	93	94	95	96	97	98	99

yes	no	and	+	—

A Cooperative Group Learning Lesson for K-3 Students with Math Learning Disability
Subtraction of 1 and 2 Digit Whole Numbers: The "Cue, Then Fade" Strategy
By Stacy Burns, Jeannie Ulechong, and Joanne Waltz

Arizona Mathematics Standard 1. Number Sense
Students develop number sense and use numbers and number relationships to acquire basic facts, to solve a wide variety of real-world problems, and to determine the reasonableness of results.
FOUNDATIONS (Grades 1-3)
IM-F3: Understand the meaning for and application of the operations of addition, subtractin, multiplication and division.
PO 1. Demonstrate with models to show the process used in subtraction (takes away, compares, finds the difference, decreases)
IM-F4: Demonstrate proficiency with the operations using whole numbers
PO 2. Add and subtract two three-digit whole numbers.
Short Term Instructional Objective: Given 5 randomly assigned two digit subtraction problems (with at least two 'challenge' problems involving three digit subtraction), the student will borrow from the 10s column to the 1s using the cuing method, with 90-100% accuracy within a 30 minute class period as determined by teacher inspection of the completed worksheet.
Social Skill Emphasis: The social interaction skill to be emphasized and practiced in this lesson is sharing the tasks.
Teacher Actions to Set Up the Face-to-Face Positive Interactions

1. Students are seated in teams of 4 with 2 partners on each side of the table, so as to face each other as well as to see the overhead transparency.
2. The teacher demonstrates the cuing method on the overhead.
3. Each team receives one worksheet of 20 two- or three-digit subtraction problems, one calculator, one pencil with an eraser.
4. The teacher asks each team to "count off from 1 to 4." The 1s will do problem #1, 2s will do problem #2, 3s will do problem #3, and 4s problem #4.
5. As each team member completes the assigned problem, the partner and the other team members observe that the cue is being used. The partner verifies the answer with the calculator. Then the calculator, problem sheet, pencil, are passed on to the next person.
6. The teacher keeps the pace brisk (approximately 3 minutes per problem) by setting the timer for 3 minutes. When the bell rings, that is the signal to complete the problem and pass the materials on.
7. The teacher monitors each team, checking to make sure that each person is fulfilling the assigned roles, and noticing how the cuing system is being used.
8. The teams rotate the materials until each student completes 5 problems.
9. The teacher conducts a Numbered Heads Together post test to verify that each person can demonstrate the cuing method, and use the calculator to verify the answer.
10. The teacher completes the lesson by asking students to briefly share with each other in a 30-second sharing, "What is the best thing that I did in today's lesson for my partner?" and "What did my partner do to help me?" What can I do to make this work better tomorrow?"
11. The teacher structures the practice session for the first 10 minutes of every math class until the students attain a proficiency level of 90-100% accuracy on a 3 minute timed test of two-and-three digit subtraction problems.
12. In addition, as soon as each member of the team achieved a proficiency level of 10 problems completed in 3-minutes, the whole team was scheduled into the computer lab to work on subtraction with regrouping using a computer assisted math skill game.

Monitoring the Social Interaction and Academic Achievement

The teacher used two methods to monitor student progress. First, a checklist of the tasks to be completed during the practice sessions revealed how often the students shared the tasks appropriately. Second, a weekly timed test of proficiency was conducted to show rate and accuracy.

Cuing Method to Practice Subtracting with Regrouping Sample Worksheet

DIRECTIONS for two-digit problems

Step 1	→	Step 2
Regroup 1 hundred.		
Subtract **ones**		Subtract **tens**

EXAMPLE: 23 – 19 equals ?

Tens	**Ones**	→	**Tens**	Ones
1	13		1	13
2	3		2	3
-1	9		-1	9
	4	→	(0)	**4**

Directions to Complete Practice Sheets: Students with the number 1 complete the problems in the first row; students with the number 2, the second row; and so on.

Row 1:

T O	T O	T O		
23	41	11	34	71
-19	-15	- 4	- 9	-59

Row 2:

T O	T O	T O		
92	84	63	53	25
-18	-17	-25	-27	- 9

Row 3:

T O	T O	T O	T O	T O
12	26	11	13	21
- 8	- 7	- 8	- 7	- 9

Row 4:

T O	T O	T O	T O	T O
71	11	10	41	23
-59	- 5	- 5	- 9	- 5

BONUS: If time permits, each person on the team will solve one three-digit problem using the cue-then-fade strategy.

DIRECTIONS for three digit problems

Step 1	→	Step 2	→	Step 3
Regroup 1 ten		Regroup 1 hundred.		
Subtract **ones**		Subtract **tens**		Subtract **hundreds**

EXAMPLE: 763-588 equals ?

Hundreds	Tens	**Ones**	→	Hundreds	**Tens**	Ones	→	**Hundreds**	Tens	Ones
	5	13		6	15	13		6	15	13
7	6	3		7	6	3		7	6	3
- 5	8	8		- 5	8	8		- 5	8	8
		5			7	**5**		**1**	7	**5**

Row 1

H T O
8 9 2
-6 4 3

2 5 4
-1 6 5

Row 2

H T O
6 8 5
-2 8 2

7 2 4
-5 4 9

Row 3

H T O
9 8 4
-7 8 8

5 8 6
-3 9 7

Row 4

H T O
3 9 2
-2 8 5

9 4 1
-3 7 8

A Cooperative Group Learning Lesson for Grades 2-5 for Students with Learning Disabilities in Math Processing Understanding the Process of Subtraction (with Negative Numbers): The "Say It Before You Do It" Strategy

by Misty Armbruster, Tracee Kasprzyk, and Andrea Woodward

Arizona Mathematics Standard 1:Number Sense

Students develop number sense and use numbers and number relationships to acquire basic facts, to solve a wide variety of real-world problems, and to determine the reasonableness of results.

FOUNDATIONS (Grades 1-3)

PO 2. Demonstrate with models to show the process used in subtraction (takes away, compares, finds the difference, decreases).

1M-F3.Understand the meaning for and application of the operations of addition, subtraction, multiplication and division

Short Term Instructional Objective: Given demonstration and model of the "Say It Before You Do It" strategy to solve three-digit mathematical problems involving borrowing, the student will correctly solve 5 problems and explain the steps to solve the problem with 90-100% accuracy within a 30 minute class session as determined by teacher inspection of the completed worksheet.

Social Skill Emphasis: Paraphrasing is the social skill for this lesson. Students are reminded to practice saying the problem in their own words. When a team member explains the process, the student will use different words to show that s/he understands.

Teacher Actions to Set Up the Face-to-Face Positive Interactions

Pre-Assessment: Schedule a time to observe students write solutions to subtraction problems that use negative numbers. If the student incorrectly answers a few problems and the errors seem to be random, or if the errors appear predictably with a specific problem this tactic might be helpful.

Prepare Problems Using Subtraction with Negative Numbers: Cut each Problem Sheet into thirds being careful to make clearly different shapes for each.

Model and Demonstration: The teacher selects one of the problems from the Problem Sheet and publicly talks through the solution on the overhead transparency or the white board or a poster paper so as to create a permanent model for students to view. Each step is labeled. Answer any questions about the process that students might have. Add steps if they suggest it. Leave the solution as it was computed (and narrated), including all the cross outs and scribbles, and remind students to refer to it if they run into a snag and cannot remember a specific step.

1. The teacher assigns students to groups of 3 by distributing the cut-up Problem Sheets at random and having the students find their partners by matching the "puzzle shapes."
2. Trios arrange their desks so that they are set apart from others and close enough to each other to hear each other solve the problems.
3. Each trio has one completed puzzle Problem Sheet with 15 problems on it and one calculator.
4. Assign each student a specific role. Have the students decide who will be the Checker, who will be the Paraphraser, and who will be the Solver. Students will rotate roles at least twice during the session so that each person has a chance to practice each of the roles.
5. The teacher monitors the timing of the solutions. The students should complete each problem within a 5 minute time period (or less). The teacher can use set a timer if that would help students monitor their pacing.
6. The teacher visits each trio to listen and observe. The teacher intervenes if needed (for example, to remind students to paraphrase, or to remind students to "Say It Before You Do It."
7. At the end of the 25 minutes, the teacher takes the remaining 5 minutes to give feedback on the students' academic competence in solving the problems and their social interaction.
8. The teacher asks students to comment on one of the following questions:
    a. What new ways did I find to solve problems like this?
    b. How well did I paraphrase? What can I do to improve the way I paraphrase?

Monitoring the Social Interaction and Academic Achievement

The teacher keeps track of accuracy and rate, noting the types of errors that recur. Future Problem Sheets are created to address the recurring errors. As proficiency (accuracy) increases, more difficult problems can be assigned. IF progress is not observed within 2 weeks, discontinue this strategy and try another one.

A Cooperative Group Learning Lesson for Grades 5-6 Students with Mental Retardation
Whole Number Addition, Subtraction, Multiplication, Division
The "Group Contingency/Peer Tutor" Strategy
by Caroline Arnott, Kristin Cunningham, and Kellie Hernandez

Arizona Mathematics Standard 1 Number Sense
Students develop number sense and use numbers and number relationships to acquire basic facts, to solve a wide variety of real-world problems, and to determine the reasonableness of results.
FOUNDATIONS (Grades 1-3)
PO 2. Demonstrate with models to show the process used in operations.
1M-F4. Student will demonstrate proficiency with the operations.

Short Term Instructional Objective: Given a 4-person team and the assignment to solve 10 addition problems with two-digit numbers, the student will use the "Doubles, Neighbors, and Two Houses Away" strategy to explain the problem solutions with 90-100% accuracy within a 20 minute time period as determined by teacher observation.

Social Skill Emphasis: Students will ensure their team mates understand the problem solution by asking, "Do you understand? Will you show me?" This method to check for understanding allows cognitive rehearsal of the procedure so that both auditory and visual cues are being used to help students retain the information.

Teacher Actions to Set Up the Face-to-Face Positive Interactions
The teacher has prepared the group in a previous session to understand the "Doubles" (problems such as 3+3 and 10 + 10), "Neighbors" (problems such as 3 + 4 and 10 + 11), and "Two Houses Away (problems such as 3 + 5 and 10 + 12) by using visuals and the number line. The posters created by the students are displayed prominently around the room.

1. The teacher makes sure the students can see the posters; each group has a bell to ring, and a calculator.
2. Each group has to solve 10 addition problems posted on the board (the first ones are basic addition/slice back , and the others become progressively more difficulty, Doubles, Neighbors, and Two Houses Away).
3. Each group assigns one person to ring the bell, another to write the problem solution, another to be the coach who gives the team a 'pep talk', and another to use the calculator to check the solution. The bell ringer is also the person who identifies "doubles" while the coach and calculator each identify "Neighbors" type of problems, and the recorder identifies "Two Houses Away" type of problems.
4. The problems are read aloud by the teacher and the class.
5. The students begin working on the problems together. When their team has a solution, the student rings the bell and announces their solution.
6. While the teacher verifies the answer, the other teams have a chance to 'challenge' only if they think it is a wrong answer.
7. Then all teams use their calculator to verify the answer.
8. Scoring: If the team who rang the bell has a correct solution, the team scores 1 point. If a team accurately challenges the answer, that team receives the point. No points are awarded for incorrect solutions.
9. Continue until all 10 problems are solved. The team with the most points wins the privilege to line up first for recess.

Monitoring the Social Interaction and Academic Achievement

The teacher keeps track of each student's accuracy and rate (number correct per time unit), the use of the strategy, and the implementation of the team roles.

A Cooperative Group Learning Lesson for Grades 3-6 Students with Learning Disability in Math
Factoring: The Slice Back Method with Mental Imagery
By Misty Brown, Michelle Tyers, and Julio Gutierrez

Arizona Mathematics Standard

Short Term Instructional Objective: Given 10 problems that use the Slice Back method to solve for factors of whole numbers, the student will achieve the solution by working with a 4-person team within a 20 minute period with 90-100% accuracy as determined by teacher observation.

Social Skill Emphasis: The social skill for this lesson is to accept answers that are different is. Learning to see the problem from the other person's perspective is a challenging social skill and very important in some areas of mathematics where alternative answers are the norm.

Teacher Actions to Set Up the Face-to-Face Positive Interactions

Mental Imagery: Teacher will explain that one way to understand and remember how to do math is to make pictures in the mind. Teacher will ask students to create images in their mind of the Slice Back and Prime Number methods. Periodically during the demonstration the teacher will pause, students will close their eyes, and picture the information on the board on their 'imaginary mental whiteboards in the center of their foreheads.'

Pre-teach: Teacher demonstrates the Slice Back method of factoring. Explain prime numbers (cannot be divided into smaller parts, or factors). The more complex the number, the more prime factors the number has.

Example: Factors of 3→1, 3

When a prime number is found as a factor, select the number necessary to get the number back up to 10. After two prime numbers have been found, then add those two numbers (the ones needed to get back to 10), to provide the next number to factor.

1. To solve this problem and others like it, you will work in teams of 4. Organize your groups so you can all see the board . Number off within your group: 1, 2, 3, 4. For the first problem, the number 1 student will begin and will be the scribe for your team.
2. Model: We'll do one problem together to make sure you understand the Factoring Game. What are the factors of 48?
    a. First student, you write the question down.
    b. Number 2 student you choose a number that can be divided into 48 with no remainder. Say: 6.
    c. Number 3 student you choose a number that can be divided into 6. Say: 3.
    d. But 3 is a prime number. The strategy is to 'slice back' to find the number that when added to 3 will make 10.
    e. Number 4 student, what is the number when added to 3 will make 10? Say: 7. Now we have 10 as the number.
    f. Number 1 student, back to you: What is a factor of 10? Say, 5.
    g. Number 2 student, you realize 5 is the second prime number. Add 7 to 5 to get the new number, 12.
    h. Number 3 student, you know that 6 goes into 12 with no remainder, but 6 has already been stated. So you say a factor is 4.
    i. Number 4 student, you say a factor of 4 is 2.
    j. Number 1 student, back to you. You realize 2 is a prime number so you add 7 (the first number needed to slice back to 10—step d above) to 2 and get 9. You know the factor of 9 is 3, and that has already been given.
    k. Now, the game is complete, and all students on your teams 'win' because you worked together to completely factor 48 into 6, 4, 3, 2.
    l. Good job. Now try the next one on your own. I'll come around to check your logic.
3. When the students have completed 2 more problems on their own, stop the class for a moment to celebrate by doing one more example as a class.
4. Ask, how did it feel to accept the different answers as each of you identified what might be a factor?
5. What can you do to feel more comfortable about getting answers that are different? How did the mental imagery help you?

Monitoring the Social Interaction and Academic Achievement

The teacher keeps a grade book on the accuracy of each student's worksheets on factoring problems. After 3 sessions of the Factoring Game, the teacher will notice if the accuracy has increased over time. If not, the Factoring Game will be discontinued and a different strategy will be implemented.

A Cooperative Group Learning Lesson for K-8 Students: Cross-Categorical (Students with LD, MR, EH)
Drill and Practice All Basic Operations: The "Create Your Own" Strategy
by Melanie Dewakaku, Lyn Neilson, and Linda Samuelson

Arizona Mathematics Standard 6: Mathematical Structure/Logic
Students use both inductive and deductive reasoning as they make conjectures and test the validity of arguments.
6M-E2. Construct, use, and explain algorithmic procedures for computing
6M-E3: Use *if...then* statements to construct simple valid arguments

Short Term Instructional Objective: Given an assortment of items, the student will create problems that require one or more of the basic operations (Multiplication, Division, Addition, Subtraction) and solve the problems with 90-100% accuracy within a 30 minute class session as determined by teacher or paraprofessional observation.

Social Skill Emphasis: The social skill emphasized in this lesson is expressing acceptance of divergent ideas so that the most unique math word problems can be generated.

Teacher Actions to Set Up the Face-to-Face Positive Interactions

1. Assign partnerships. Each partner has a blank piece of paper, magic markers, poker chips, and an equation board for solving problems (slate board with chalk).
2. Set a timer and say, "Each of you has all the time you need to make up a Problem Worksheet using all 4 math operations with at least two-digit whole numbers. You have 2 minutes to do this. Write neatly because you will send your Problems to your Partner to solve. You will solve the Problems created by your Partner."
3. Ask Pause, set the timer, circulate to make sure students are doing the task.
4. When the bell rings, congratulate their diligence. Ask the students to give their Problem Worksheet to their partner to solve. Say, "Good! Let's hear some of the problems each of your partner teams have devised." [Poll 2 or 3 examples to get the flavor of the complexity and range of operations used.]
5. OKAY. Now it's time to practice solving problems. Now you have 10 minutes to solve the problems that your partner created. When you are done, put your pencils down so I'll know you are ready for the next step. I'll let you know when time is up."
6. Circulate to observe how the students are solving the problems. Take special note of students who use the poker chips for numeration, the slate board for calculating, and any heuristic or mnemonic or strategy (e.g., Say It Before You Do It). Tally number of times the students express acceptance.
7. When the bell rings, say, "OK! Now it's time for you to use your calculators to check your answers. You have 5 minutes to do this. Work together on each of your Problem Worksheets." [Set the timer.]
8. When the bell rings, say, "Let's find out how you did. Partners, raise your hand if your partner did a good job on the Problems Worksheet you created!" [Pause, notice hands raised.]
9. Poll 2 or 3 partner teams to find out what was the best part of this lesson. Be sure to note that they were very 'quick' with regards to completing the worksheets (compared to other types of worksheets).
10. Ask your partner, "Did I think of different ideas for my problems? "
11. Poll their answers.
12. Ask your partner, "What can we do to think of even more different problems?"
13. Poll 2 or 3 of their answers.
14. Based on the level of complexity (or simplicity) of the Problems generated, decide what to teach for the next lesson.

Monitoring the Social Interaction and Academic Achievement

The teacher monitors the number of problems created, number of operations used, and the percentage correct. Report to the class the number of times that students were observed to accept divergent ideas.

A Cooperative Group Learning Lesson for Grades 6-12 Students
Cross Categorical (Students with LD, MR, EH): Solving Math Problems with Mnemonics
by John Carreon, Renee Crawford, and Christine Wolcott

Arizona Mathematics Standard 6: Mathematical Structure/Logic
Students use both inductive and deductive reasoning as they make conjectures and test the validity of arguments.
6M-E2. Construct, use, and explain algorithmic procedures for computing
6M-E3: Use *if...then* statements to construct simple valid arguments
PO 2. Solve problems using deductive reasoning.

Short Term Instructional Objective: Given a series of complex word problems at the student's frustration reading level, students will apply the RIDGES mnemonic to task analyze the problem so as to increase success in solving word problems. The student will apply the 6-steps of the RIDGES mnemonic (Read, Identify known variables, Draw a picture, G stands for goal in writing, E for equation, S for solve the problem) with 100% accuracy within a 30 minute instructional session as determined by teacher observation of the lesson and by inspection of the process used to calculate the solutions.

Social Skill Emphasis: The social skill to be practiced in this lesson is "division of labor" with each member of the 3-person team taking the responsibility to practice 2 of the 6 steps.

Teacher Actions to Set Up the Face-to-Face Positive Interactions

1. The teacher assigns students to groups of 3, with person 1 taking the RI steps, person 2 taking the DG steps, and person 3 taking the ES steps.
2. The teacher refers to the RIDGES mnemonic which has been posted prominently throughout the room. The students had previously prepared the posters in English language class, looking up the word *mnemonic*, making colorful posters to help remember the meaning for each of the steps.
3. The trios begin solve the first 3 word problems.
4. Then the teacher says, "OK! Now it's time to switch roles. Person 2 it's your turn to do the RI steps, person 3 you'll do DG, and person 1 you'll do ES steps. Continue with the next 3 problems."
5. After about 10 minutes, the teacher says, "Good progress! Now it's time to switch roles one more time. Person 3 it's YOUR turn to do the RI steps; person 1 you'll do DG; and person 2 you'll do ES. Complete the next 3 problems."
6. After about 10 minutes, the teacher says, "GREAT JOB! Now I know that each of you can do each of the steps of the mnemonic RIDGES! It's time to put it altogether. You'll each do Problem #10 independently using the RIDGES strategy on your own. Get started!"
7. After about 5 minutes, (or sooner if all are finished), the teacher asks, "OK. Tell your team mates how you used RIDGES to solve the problem."
8. For the next 5 minutes, the teacher circulates to hear each person explain, show and tell how RIDGES was used.
9. When the time is up, say, "Now let's discuss the impact of this method. Raise your hand if you noticed that solving word problems is a little easier than when we started. Yes! I agree. Raise your hand if you noticed that your team mates might have drawn a different picture to represent the problem and it still came out with a correct answer. YES! It's true...the way we picture the problems can vary. Raise your hand if you had differences in how to write the equations? Yes...that's true too...equations can vary and still be correct. Now, raise you hand if you all got the correct answer! Yes!"
10. Assign a team challenge: Find a word problem that is very challenging. Bring it to class tomorrow on a 3 x 5 index card. We'll exchange cards: 1 team will use RIDGES and another team will not. We'll compare how effective RIDGES is.

Monitoring the Social Interaction and Academic Achievement

Using a pre-test/post-test method to assess the impact of RIDGES can let the teacher know how much influence the strategy has on motivation and accuracy. The word problems really have to be complex enough so that students can't solve by intuition. The more complex the problems the more useful the strategy is in helping students sort the relevant from irrelevant information.

The RIDGES Mnemonic

	Read the problem for understanding You may want to read it 2 or 3 times. Be sure you understand what you are reading. Look up the definitions of unfamiliar words. Ask a friend or the teacher!
	I know statements. List all information given in the math problem.
	Draw a picture. Keep it simple.
	Goal statement. Declare in writing what you want to know.
	Equation development Write a math equation that tells the problem in numbers.
	Solve the equation! Plug in the necessary information to reach the goal and solve the equation.

A Cooperative Group Learning Lesson for Grades 6-12 Students with Learning Disability in Reading
Solving Math Problems with Heuristics
By Patricia Martin and Nancy Truhler

Arizona Mathematics Standard 6: Mathematical Structure/Logic
Students use both inductive and deductive reasoning as they make conjectures and test the validity of arguments.
6M-F3: Distinguish between relevant and irrelevant information.
PO 1. Select the information necessary to solve a given problem.
Short Term Instructional Objective: Given a series of math problems to solve, and working as a member of a cooperative learning group, the student will apply 6 heuristics to analyze the problem, organize relevant information, select the correct symbol for the math operation, generate an appropriate equation, and solve the problem within a 50 minute class session as determined by teacher observation and inspection of the written solutions.
Social Skill Emphasis: In this lesson, students will take turns being the Heuristics Coach by giving direction to group work. The Heuristics Coach maintains the team's checklist of their Use of Heuristics.
Teacher Actions to Set Up the Face-to-Face Positive Interactions

1. Students are assigned to groups on a random basis with up to 4 students per group.
2. The student whose last name has the fewest number of letters is the first Heuristics Coach.
3. Each group is assigned at least 10 problems (arranged on 3 x 5 cards for ease in handling and for exchanging with other groups).
4. Group members receive roles of Heuristic Coach, Timekeeper, Recorder, and Encourager. After each problem is completed, they exchange roles until each person has had at least two chances to be the Heuristics Coach.
5. The students apply the heuristics checklist to each problem, coming to consensus as to which heuristic is most useful for that particular problem.
6. The teacher visits each team to ensure accurate application of the heuristic, and to intervene to teach either the academic skill, or the coaching of the heuristic.
7. This should be a somewhat moderately paced lesson so the teacher will monitor to make sure that students move along from problem to problem within a 3-5 minute period.
8. At the end of 45 minutes the teacher calls time and asks for feedback. The "Class Heuristics Usefulness Chart" is completed by polling each group, asking for a show of hands for whether or not the heuristic was useful for the set of problems.
9. The teacher asks each team to complete the sentence, "Something that my team members did today that helped me learn is _____."
10. The teacher collects the Heuristic Coach Checklists for each team and reviews it to decide what to emphasize for the next lesson.

Monitoring the Social Interaction and Academic Achievement
In addition to the student's self-monitoring of the team's use of the 6 heuristics, the teacher will maintain a checklist for the students' accuracy and rate. As proficiency increases, the difficulty and complexity of assigned math problems will be subtly increased.

Sample Heuristics Coach Checklist (and Class Heuristics Usefulness Chart)

Heuristic Used for Problem (Check if used; Mark * if useful)	1	2	3	4	5	6	7	8	9	10
Analogy (Brainstorm "possible" real-world problem like this one)										
Annotating (Use Blue Highlighter on the Verb Hint: Verbs can give a clue *re* the Operations)										
Details Analyzed (Use Pink Highlighter for Important Information)										
Delete Irrelevant Information (Use Green Highlighter to cross out)										
Symbolize the Operations (x, ./., +, -, [ ], etc.)										
Designate with Formula (Equation)										

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